

TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE

UTAH

NATURAL RESOURCES CONSERVATION SERVICE

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ENG -210 - TECHNICAL NOTE UT210-15-05
190-VI

SUBJECT: ENG – Water Needs of Windbreaks for Trickle Irrigation System Design

Purpose. To provide information on the water requirements for windbreaks for trickle irrigation system design.

Effective Date. Upon receipt.

Contents of Technical Note.

Optimum plant growth and survival of windbreaks during establishment is necessary to provide the planned level of protection. The majority of windbreaks in the State of Utah occur in an arid to semi-arid environment. Water needs for temporary or permanent irrigation must be considered for optimum plant growth and survival in most areas. The accompanying procedure aids in determining the degree of irrigation development needed taking into consideration the climatic conditions, soil, and plant species.

The objective of the Natural Resources Conservation Service is to ensure optimum plant growth and deep root establishment for windbreaks. This objective is accomplished by providing adequate water during critical growth period in a timely manner and with proper placement of lines and emitters to ensure balanced root growth. The amount of water supplied depends on the annual moisture received and the capacity of the soil to retain sufficient moisture for the desired plant species response.

Species suited to various soils and their expected growth under irrigation are contained in Section II of the Field Office Technical Guide, Windbreak Suitability Groups. To achieve the expected growth indicated in Section II, four system design levels must be considered for optimum and sustained plant growth and vigor. Based upon well drained, non-saline soils and species suitability, they are:

Level 1: Permanent full irrigation designed for peak use.

Level 2: Permanent irrigation to the tenth year of growth with capacity to supply supplemental water during drought years and during warm spells.

Level 3: Temporary irrigation installation to the third year of establishment (the system removed thereafter); however it is recommended that the system be retained for growing HIGH water use group species and in locations that have a history of drought or long warm spells.

Level 4: No system is needed unless the area exhibits a history of drought or extensive warm spells, or the landowner desires accelerated tree and shrub growth.

Table 1 below, used with the peak “alfalfa grass” daily use factor from the Utah Irrigation Guide and the potential plant rooting width from Table 2 by plant species, can be used to complete the Water Needs Worksheet, Attachment 1. The results of the work sheet will establish the water need and system life requirement for the planned or existing windbreak being evaluated.

The design level will ensure compliance with the purpose of farmstead and field windbreak standards: To protect the soil resources, control snow depositions, prevent wind damage, protect farmsteads, crops, livestock, orchards, and wildlife, or increase the natural beauty of the area.

The procedure followed by using the Water Needs Worksheet, Attachment 1, is intended for trickle irrigation supply systems. However, the determination of windbreak water needs is applicable to all forms of irrigation.

Table 1

Mean Annual Precip.	AWC Total to 60 in.	Design Level	Water Use Factors		
			Plant Species Water Use Group		
			Low	Medium	High
<12	All	1	31	53	84
12-18	<7.5	1	31	53	84
	>7.5	2	19	32	51
18-35	<3.5	2	13	32	51
	3.75-7.5	3	9	16	25
	>7.5	4	0	0	0
>35	<3.75	3	9	16	25
	>3.75	4	0	0	0
Design Levels: Level 1 Permanent full irrigation designed for peak use. Level 2, Permanent irrigation to the 10th year of growth. Level 3, Temporary irrigation for establishment of windbreak (3 years). Level 4, No supplemental irrigation needed.					

Table 2

Water Use Consumptive Groups	Typical Between Tree Spacing		Typical Root Width at 20 yrs. (ft)
	Multi. Row (ft)	Single Row (ft)	
High Use Group			
Lombardy Poplar	6-8	4-6	30
Hybrid Poplar	10	8	30
Golden, Black, or Weeping Willow	12	8	30
Medium Use Group			
Black Locust, Siberian Elm, Green Ash	12	8	30
Austrian Pine, Ponderosa Pine	12	8	30
Eastern Red Cedar	8	8	15
Scotch Pine	12	8	20
Blue Spruce, Norway Spruce, Douglar Fir	12	8	25
Northern White Cedar	8	6	20
Low Use Group			
Siberian Peashrub, Common Lilac	5	3-4	10
Amur Honeysuckle, Common Privet	5	3-4	8
Nanking Cherry, Peking Cotoneaster	5	3-4	4
Russian Olive	10	8	20
Rocky Mountain Juniper	8	6	15

Notes:

1. Match consumptive use and root zone width for a species not listed with one that is.
2. "Typical Between Tree Spacing" for trees can aid in early placement of emitters.
3. The "Typical Root Width" at 20 years is not to be used for actual row-to-row spacing (the width indicates a root density factor for irrigation computations only).

WINDBREAK DRIP IRRIGATION

WATER NEEDS WORKSHEET

Step 1 – Select the peak daily consumptive use for the proper climatic zone and alfalfa grass: _____

Step 2 – Record the selected species and their water use factor from Table 1.

Row	Species	Use Factor
1		
2		
3		
4		
5		
6		

Step 3 – Record the species root width from Table 2, and the row length, and calculate the area to be wetted.

Row	Species Root Width (ft)	Row Length (ft)	Area=W*L
1			
2			
3			
4			
5			
6			

Step 4 – Determine gallons per day needed per windbreak row. The basic equation is: (Consumptive Use*Use Factor*Area)/Efficiency

Row	C.U.	*	Use Factor	*	Area	/	Effic- iency	=	gal/dy/ row	/	# Trees/ row	=	gal/day/ tree
1		*		*		/		=		/		=	
2		*		*		/		=		/		=	
3		*		*		/		=		/		=	
4		*		*		/		=		/		=	
5		*		*		/		=		/		=	
6		*		*		/		=		/		=	

Efficiencies: Point Source on Ground = 90%
 Point Source Suspended = 80%

Spray Emitters = 80%
Bubbler = 85%

Step 5 – Determine gallons per day needed from ages on to twenty by the following equation:

$$(\text{Species Age}/20)*\text{gal/day/tree}$$

For species with high-medium water use, using 2-3 emitters per species will reduce irrigation set times and aid in better root development.

Step 6 – The System will be (check one): Permanent _____ Temporary _____.

Step 7 – The system will need to be designed and balanced to provide the necessary amounts of water in a manner that will meet the uniformity required. System design must be approved by a person with appropriate engineering job approval authority or by a certified irrigation dealer.

Design Aid: Spreadsheet to aid in calculating water requirements.

<http://efotg.sc.egov.usda.gov/references/public/UT/windbreak.xls>

Filing Instructions. File in the Technical Notes notebook under ENG-210

Contacts: Brent Draper, State Irrigation Engineer, 801-524-4582
Aimee Rohner, State Design Engineer, 801-524-4263

DAVID C. BROWN
State Conservationist